Impacts of Access Management Techniques
(Part 1)

Paper 6A. The Economic Impacts of Medians: An Empirical Approach

Jerome E. Gluck, Urbitran Associates

Herbert S. Levinson, Transportation Consultant

Paper
Slides 6B. Developing a Methodology to Determine the Economic Impacts of Raised Medians on Adjacent Business

Bill Frawley, Texas Transportation Institute

Paper 6C. Economic Impacts of Access Management

Kristine M. Williams, University of South Florida

Monday August 14, 2000 – 1:00 PM – 2:30 PM
Track 2 - Technical

THE ECONOMIC IMPACTS OF MEDIANS

An Empirical Approach

Prepared by:

Herbert S. Levinson, Transportation Consultant
40 Hemlock Street
New Haven, Connecticut
Tel: (203) 389-2092

and

Jerome S. Gluck, Urbitran Associates
71 West 23rd Street, 11th Floor
New York, NY 10010
Tel: (212) 366-6200, **Fax:** (212) 366-6214
E-mail: jerryg@urbitran.com

Prepared for:

4th National Conference on Access Management
August 13-16, 2000
Portland, Oregon

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ABSTRACT

The Economic Impacts of Medians: An Empirical Approach
By:
Herbert S. Levinson, Transportation Consultant
Jerome S. Gluck, Urbitran Associates

The installation of physical (non-traversable) medians improves traffic operations and safety. However, by restricting or diverting left turns, medians may affect roadside businesses. Estimating these economic impacts becomes important in helping to decide when and where to install a physical median.

This paper describes the economic considerations associated with installing these medians. It presents a simplified procedure for quantifying the estimated impacts of installing a raised median based on upon the following factors: the number of vehicles that turn left into a roadside business, the proportion of these turns that represent pass-by traffic, and the estimated annual sales of the business. Examples are presented. The estimates derived from this procedure represent the maximum likely impacts, since normal traffic growth and overall economic growth are likely to offset some of the potential loss.

DISCLAIMER

The research reported herein was drawn from work performed for NCHRP 3-52, Impacts of Access Management Techniques. The opinions and conclusions expressed or implied in this report are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

1.0 INTRODUCTION

Physical (non-traversable) medians separate opposing directions of flow and provide refuge areas for left turns, and pedestrians. They improve safety with reported 10 to 15% fewer accidents per vehicle mile than other median alternatives. However, the installation of a physical median limits direct access to most land developments. The prohibition and/or rerouting of left turns may require longer travel distances and changed routes of access. This, in turn, can limit both the accessibility and effective exposure of a site. Conversely, improved traffic operations associated with installation of medians may improve accessibility and exposure.

The economic impacts of a physical median, therefore, largely reflect the extent to which access is improved, restricted or denied. This is because property acquires value because of its location, and the keys to locations are accessibility and exposure. Accessibility is measured by the ease that people and vehicles can reach, arrive at and depart from a site; exposure is measured in terms of the number of people and vehicles that pass a site.

Measuring and assessing the impacts of restricting left turns has been difficult. The impacts not only depend upon the extent that access to adjacent property increases or decreases, but also on the type of activity involved and the background economic conditions. (1) Some activities, such as a regional shopping center or office complex attract their clientele from a large area, and the overall access time to markets play a major role. Other activities, such as service stations and drive-in restaurants, rely on intercepting pass-by traffic; in such cases, left-turn restrictions and increased travel distances could adversely affect businesses. (2) The impacts of left-turn restrictions also depend upon changes in business conditions and traffic volumes, shifts in population and purchasing power, and the development of competitive business sites.

2.0 PREVIOUS STUDIES

Several studies have attempted to analyze the actual impacts of installing medians. Most, however, have been based on perceptions of impacts and attitudes of the various groups impacted.

Texas Cities (1, 2, 3). The impacts of raised medians on left turns and sales volumes were analyzed for Baytown, Pleasantville, and San Antonio in 1964. The key findings are shown in Table 1. (1) The total number of left turns as a percent of ADT declined, both before and after the restrictions as the ADT increases. This suggests a lower attraction of far-side (left turning customer) traffic under high volume conditions. (2) "Traffic serving" businesses that were not located at median openings reported a 44% decline in sales volumes after median construction, while non-traffic-serving businesses reported no change.

Georgia Studies. The economic impacts of installing raised (non-traversable) medians on Jimmy Carter Boulevard and Memorial Drive in Metropolitan, Atlanta Georgia were identified as part of ongoing safety and operations studies.

1. Jimmy Carter Boulevard (4). A 3.5-mile (5.6-km) section of Jimmy Carter Boulevard was changed from five lanes (four through lanes, plus a continuous two-way left turn lane) to six lanes with a raised median in 1988. The new roadway provided six through lanes, protected left turning lanes at signalized intersections, and a 10-inch high 2-foot wide concrete median. (A "Jersey" barrier was used temporarily from April 1987 through August 1988). Except for one location, all median breaks were signalized, and "U" turns at median breaks were allowed. Daily traffic volumes on Jimmy Carter Boulevard increased between 20 and 37% since 1985. Flows in the "central" section exceeded 60,000 vehicles per day while on the northern and southern sections volumes exceeded 50,000 vehicles per day.

The economic impacts of the raised median were identified by comparing tax records of businesses along the roadway for a 1-year period with the two-way left turn lane (before) with a corresponding period "after" the raised median was built. Twenty-one businesses reported a decrease in sales receipts, with the decreases ranging from 0.25 to 56 percent. Fifteen businesses reported an increase in sales receipts, with the increases ranging from 0.32 to 848 percent. These comparisons suggest that the raised median did not result in any overall negative impact, although some individual mid-block businesses (i.e. businesses located between median openings) may have suffered some loss of sales. The businesses that were reported to suffer ended up on the "wrong" side of a median, such as a liquor store or grocery store located on the "going to work" side, and a breakfast restaurant located on the "coming to home" side.

2. Memorial Drive (5). Daily traffic volumes along the five-mile section of six-lane Memorial Drive range from 35,000 to 55,000 vehicles per day. During 1990, a 10-inch raised median replaced two-way left turn lanes. Median openings were limited to the 14 signalized intersections. Dual left turn lanes were often provided, with the inside lane signed specifically for "U" turns.

The changes in business activity along Memorial Drive reflected the overall economic climate as well as introduction of the physical median. A December 27, 1992 article in the Atlanta Journal and Constitution stated that, after the raised median was installed, several businesses (including Blockbuster Video and Ace Hardware) closed and one business (Citgo Food Mart), located on a cross road, had reportedly lost 50 percent of its business. However, the specific reasons for closing were not identified.

Florida Experience. Attitudes and impacts associated with medians were obtained for roadways in Fort Lauderdale, and in Broward, Orange and Seminole Counties.

1. Oakland Park Boulevard - Fort Lauderdale (6). This six-lane boulevard carries 50,000 vehicles per day. A 2.25-mile (3.6-km) section included 4 signalized intersections and 33 unsignalized median openings. Land use is primarily commercial.

A retrofit project eliminated 17 (approximately one-half) of the original 33 unsignalized median openings. The remaining 16 median openings were reconfigured to allow only two turning movements, the U-turn and left turn movements from only one direction of travel along the artery. The unsignalized left turn movement was alternated to serve opposing directions of travel. In addition, three new openings that allowed for only the U-turn maneuver were added.

Public opinion surveys were conducted of the various interest groups most directly affected by changes in median design and traffic operations along both roadways. The groups included through-travelers, delivery-truck drivers, nearby residents, adjacent merchants, and customers. The surveys obtained information regarding attitudes toward median changes as well as impacts on customer behavior and business activity. The findings relating to economic impacts are summarized in Table 2.

Some 63% of the 141 residents, customers, and truckers surveyed felt inconvenienced by U-turns, and some 44% of the residents and customers reported that U-turns affect the choice of businesses visited. Some 70% of the 96 responding merchants reported no adverse effect on business truck deliveries, and 84% reported making no change in their business operations. Most of the businesses (61 to 72%) reported no change in the number of customers, profitability, and property values. About 15% reported a reduction in property values and 28% reported a decrease in profit, while 6% reported an increase in profits. Thus, the reported losses were partially offset by increases.

2. Broward, Orange and Seminole Counties, 1995 (7). Drivers and businesses were surveyed along State Routes 423 (Lee Road), 436, 520, and 600 during 1995 to obtain attitudes and perceptions regarding the effects of restricted medians. The results of these surveys are summarized in Tables 3.

- Drivers generally perceived the median changes favorably and believed safety and traffic flow were improved. However, 43% of the 201 respondents indicated they were unduly inconvenienced by U-turns. U-turns affected driver choice of destination -- the range was from 16% for offices to 43% for gas stations. About 21% reported major concerns with the design.

- Thirty-six percent of the 21 businesses surveyed indicated that the median changes adversely affected truck deliveries and 25% made business changes in response to the revised median design. Some 19% reported that business volume increased in the last two years and 38% reported no change in their business. Some 41% of the 21 respondents reported major problems with the design.

NCHRP 25-4 (8). This research analyzed the economic impacts resulting from restricting left turns. It included surveys and interviews with impacted businesses, as well as selected statistical analyses.

1. Perceptions. Attitudes and perceptions were mixed. Some business owners felt that the left turn restrictions limited access to their stores and resulted in lost businesses, while others reported that the turn restrictions reduced congestion and improved traffic flow to the point where their market areas actually expanded.

Businesses located at midblock locations (i.e., away from intersections) perceived the left turn restrictions as more detrimental than businesses located at places where left turns were permitted. In some cases, left turn restrictions appeared to cause some sales to shift from the restricted to the unrestricted business locations. Some businesses that reported losses because of left turn restrictions were ready to go out of business before the restrictions were implemented or were planning to go out of business for other reasons.

Perceptions of impacts also varied depending on the purpose of the project. There was some evidence to suggest that where safety had been publicly perceived to be a serious problem, the left turn restriction actually enhanced the number of customers coming into the area. However, where projects were intended to improve traffic speeds and flow, perceptions were mixed. Some businesses wanted customers to travel at slower speeds in front of their establishments. While other businesses reported that increased speeds allowed their market areas to be expanded.

Patron attitudes and travel behavior were obtained from 230 interviews conducted at 10 sites in New Jersey, New Mexico, New York, Oregon and Pennsylvania. About 110 (47 percent) were aware of the project. Some 49 of these (44 percent) were “pass-by convenience” trips while 62 trips (56 percent) were special destination trips. Fifty-three patrons visited businesses both before and after left turn restrictions were implemented. About 80% continued to visit establishments with the same frequency.

About 55% reported no change in travel times, 33% reported larger travel times and 12% shorter travel times.

2. Sales Impacts. The sensitivity of business sales as derived from this research is shown in Table 4. The key findings – based on limited statistical analysis – were as follows:

- Gas stations, food stores, and personal service businesses appeared to be the most adversely affected. These businesses showed the largest declines in sales and the highest rates of business failures. The declines in sales were statistically significant in both cases, while the business exits were statistically significant only for gas stations.

- Declines in sales and business exits for general service businesses, and durable goods retailers were not statistically significant.

3.0 GENERAL APPROACH

A simplified empirical approach was derived for estimating the economic impacts associated with left turns. This approach builds upon the preceding research efforts. It also draws upon available studies that quantify the proportions of "pass-by" traffic for various activities, and the likelihood of left turns under various traffic volume conditions.

Where direct left turns are prohibited, some motorists will change their driving or shopping patterns to continue patronizing specific establishments. Some repetitive pass-by traffic will use well-designed or conveniently located U-turn facilities. Retail sales may increase as overall mobility improves, or as economic conditions change, and as traffic volumes increase. It is also reasonable to expect that destination-oriented trips will find alternate routes to their destinations.

The maximum economic impact associated with installing a raised median and limiting certain access points to right turns will depend upon the following factors:

- Size and type of each abutting land use at the locations where left-turn access will be eliminated.
- The reliance of each land use on pass-by traffic.
- The number of vehicles turning left into the activity or land use.
- The average purchase per vehicle (or person).

Thus, for any site where left-turn access is denied, the maximum adverse impacts may be represented the product of (1) the number of left turn entrants and (2) the proportion of those turns that represent pass-by (intercept) trips. The economic loss would represent the average dollars per purchase times the number of trips involved.

The economic impacts over a section of highway should be summed for the individual establishments involved. Thus, the maximum loss would be:

$$\sum_{1}^{M} N_i P_i D_i \qquad (1)$$

where N_i = Number turning left at location i.
P_i = % pass-by at location i
D_i = Dollars/Purchase
M = Number of establishments where left turn entrance is denied.

The percent of pass-by traffic can be estimated based upon the proportions reported in various studies. Specific values are given in Table 5. The actual number of left turns can be observed in the field.

The resulting economic impact model is shown in Table 6. Column A in Table 6 gives generalized percentages of pass-by traffic for typical commercial uses. Typical proportions of pass-by traffic are as follows:

Service Station-Convenience Market	55%
Small Retail (<50,000 sq. ft.)	55
Fast Food Restaurant with Drive Through Window	45
Shopping Center (250,000 - 500,000 sq. ft.)	30
Shopping Center (Over 500,000sq. ft.)	20

Column B of Table 6 gives estimated proportions of left turns as a percentage of the total entering traffic. These percentages were derived from analyses of gas station customers in three cities. They show a declining proportion of left turn entrants as daily traffic volumes increase. At 10,000 ADT about 40% of the traffic entering an establishment would be estimated as entering from the left. At 30,000 ADT this proportion reduces to about 15 percent.

Several examples illustrate the application of Table 6.

- Assume that 500 vehicles per day turn left into a community shopping center of 300,000 square feet. From Column A of Table 6, 30 percent of these vehicles are estimated to represent "pass-by" traffic. Thus, the maximum daily loss in traffic would be about 150 vehicles per day. If the average purchase is $20 per vehicle, the daily loss is estimated to be $3,000. Note that the remaining 70 percent of the left-turn entrants would be expected to change their travel patterns to reach the community shopping center.
- Assume that left turns will be prohibited into a service station along a road with 10,000 ADT. From Column A of Table 6, the pass-by traffic is estimated to represent 55 percent of the total. Column B of Table 6 shows that 40 percent of the entrants are turning left. Thus, a maximum of 22 percent (i.e. 0.55 x 0.40) of the customers would be lost if left turns were prohibited.
- Assume that left turns will be prohibited into a high-turnover restaurant along a roadway carrying 30,000 vehicles per day. The pass-by traffic is estimated to account for 40 percent of the total entrants. About 15 percent of the customers are estimated to turn left into the restaurant. The anticipated maximum impact would be a 6-percent loss in customers.

To estimate the maximum daily and annual economic loss, information would be needed on the purchases per vehicle (or customer) at any given establishment – both on a daily and annual basis.

4.0 IMPLICATIONS

The suggested approach for estimating the maximum likely adverse impacts of restricting left turns is both straightforward and intuitive. It should be reiterated that impacts would be less where alternate left-turn access into a property remains open. Over a section of highway, sales at other establishments might increase because of the improved accessibility. Finally, there may be no overall impact on a community since business traffic would divert to other establishments.

A logical next step is to conduct field tests of the recommended approach. This would involve interviews with customers in selected establishments to determine:

1. How they entered various establishments (i.e. by turning left or right),
2. Whether or not they are pass-by traffic, and
3. How they would respond to changes in left-turn access

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LIST OF TABLES

TABLE 1

REPORTED IMPACTS OF NON-TRAVERSABLE MEDIANS IN THREE TEXAS CITIES

A. Relationship Between Total Left Turns and ADT Before and After Construction

Location	Roadway ADT	Total Left Turns				
		Before	% ADT	After	% ADT	Change
Pleasanton	3,000	90	3.0	50	1.7	-56%
Baytown	6,000	101	1.7	50	0.8	-50%
San Antonio	21,000	237	1.1	95	0.5	-40%

B. Changes in Gross Business Sales During and After Construction

Location	Change in Gross Business Sales	
	During Construction	After Construction
Pleasanton	-6%	-14%
Baytown	-6%	- 3%
San Antonio	0%	+ 5%

Source: Adapted from References 1, 2, and 3.

TABLE 2

OPINIONS REGARDING MEDIAN CHANGES ALONG OAKLAND PARK BOULEVARD

A. Opinions of Merchants

96 Merchants Responded		Percent Response	
Questions		**Yes**	**No**
Has median changes adversely affected truck deliveries?		30	70
Has median changes caused major changes in business:		16	84
How have property values changed due to the median change?	Increased	13	
	No Effect	72	
	Decreased	15	
How has the median change affected profits?	Increased	6	
	No Effect	66	
	Decreased	28	
How has the median change affected the number of customers?	Increased	10	
	No Effect	61	
	Decreased	29	

B. Opinions of Residents, Customers, and Truckers

TYPE OF RESPONDENT				
	Residents	**Customers**	**Truckers**	**Total/Average**
Number of Respondents	87	42	12	141
Questions	**PERCENT OF RESPONSE**			
Feel Inconvenienced by the Need for U-turns?	63	55	45	63
U-turn Affects Choice of Business Visited?	41	51	-	44

Source:
Long, G., and Helms J., Median Design for Urban Roadways, Transportation Research Center, University of Florida, Gainesville, Florida, October 1991.

TABLE 3

RESPONSES TO SURVEY QUESTIONNAIRES REGARDING MEDIAN CHANGES BROWARD, ORANGE, SEMINOLE COUNTIES, FLORIDA

A. Business Survey

Item		% Responding Favorably
Adversely Affects Truck Deliveries		36
Made Business Changes		25
Business Volume Changes within Last Two Years		
	Increased	19
	No Change	38
	Decreased	43
Major Problems with Design		41

Note: 21 responses

B. Driver Survey

Item		% Responding Favorably
Improved Safety		75
Better Traffic Flow		84
In Favor of Design		82
Unduly Inconvenienced by U-turns		43
U-Turns Affect Choice of Destination		
	Gas Stations	43
	Fast Food Restaurants	36
	Shopping Center	33
	Convenience Market	29
	Quality Restaurant	22
	Office	16
Major Problems with Design		21

Note: 201 responses

Source: Ivey, Harris & Walls Inc. Technical Manual -- Corridor Land Use, Development & Driver/Business Survey Analysis, District Wide Median Operations Evaluation, Florida Department of Transportation, November 1, 1995.

TABLE 4

ILLUSTRATIVE EXAMPLES OF BUSINESS SALES SENSITIVITY TO PASS-BY TRAFFIC

Proportion of Business Sales Coming from Pass-by Traffic	Standard Industrial Class (SIC)	Sample Business Type
Highest	549	Miscellaneous Food Stores
	554	Gasoline Service Stations
High	541	Grocery Stores
	721	Laundry, Cleaning and Garment Services
Moderate	525	Hardware Stores
	572	Household Appliance Stores
	753	Automotive Repair Shops
Lowest	527	Mobile Home Dealers
	555	Boat Dealers
	722	Photographic Studios
	802	Dentists

Source: Neuwirth, R.M., Weisbrod, G.E., Decker S., "Methodology for Evaluating Economic Impacts of Restricting Left Turns" in Compendium of Papers 1st National Conference on Access Management, Vail, Colorado, August 1995.

TABLE 5

REPORTED PASS-BY TRIPS AS PERCENT OF TOTAL (AVERAGES)

Land Use	No. of Sites	A AM Peak Hour	B PM Peak Hour	Source
Convenience Stores			71	9
Convenience Mart with Gasoline Pumps	15	62	66	10
Convenience Mart	20		60	11
Gasoline Service Station with Convenience Mart	9	61	56	10
Gasoline Service Station	6	58	52	10
High Turnover sit-down restaurant	6		40	10
Fast Food Restaurant with drive-through window	25	45	47	10
	7		43	
Supermarkets	5	5	27	12
Discount Stores			42	11
			22	12
Shopping Centers	67			11
50,000 sq. ft.			60	
100,000			45	
200,000			36	
300,000			31	
400,000			28	
500,000			27	
250,000			22	
1,000,000			21	

1,000,000			21	

TABLE 6

ECONOMIC IMPACT MODEL

Land Use	(A) % Pass-by Traffic	(B) Estimated Left Turns As % of Total Entering Traffic	
1 Gasoline Service Station Convenience Market Small Retail < 50,000 sq. ft.	55	**ADT** 5,000 10,000 20,000 30,000 or more	**%** 43 40 30 15
2 Fast Food Restaurant with Drive Through Window Supermarkets Shopping Center 50,000 - 100,000 sq. ft.	45		
3 High Turnover sit-down restaurant	40		
4 Shopping Centers 250,000 - 500,000 sq. ft.	30		
5 Shopping Centers Over 500,000 sq. ft.	20		

Source: (A) Estimated from Table 5, Column B

Source: (B) Herbert S. Levinson

CASE STUDIES OF ECONOMIC IMPACTS OF RAISED MEDIANS ON ADJACENT BUSINESSES: STUDY METHODOLOGY AND RESULTS

by

William L. Eisele, P.E.
Texas Transportation Institute
Texas A&M University System
3135 TAMU
College Station, TX 77843-3135
Ph: 979.845.8550
Fax: 979.845.6008
e-mail: bill-eisele@tamu.edu

and

William E. Frawley, AICP
Texas Transportation Institute
110 N. Davis Dr., Suite 101
Arlington, TX 76013
Ph: 817.462.0533
Fax: 817.461.1239
e-mail: w-frawley@tamu.edu

ABSTRACT

The use of raised medians in urban areas has increased in recent years. Raised medians restrict access to businesses along a corridor by limiting turning movements to select mid-block locations. Therefore, a very common remark at public hearings related to the construction of raised medians is that there will be detrimental economic impacts on adjacent businesses. However, the restricted access allows more efficient signalization and traffic flow along the corridor, potentially providing more customers for the businesses. Although many studies on the affect on traffic operations exist, little research is available on the economic impact from raised medians on adjacent businesses and properties.

The authors of this paper have completed a four-year project developing and testing a methodology to collect and analyze data related to the economic impact of raised medians on adjacent businesses for the Texas Department of Transportation (TxDOT). This paper summarizes the findings of key economic indicators, as well as perceptions of business owners and managers. The research has found that installation of a raised median does not equate to economic losses by adjacent businesses. In fact, only two types of businesses (auto repair shops and gas stations) were found to generally experience losses in gross revenues. In almost all cases, employment did not change. This research is anticipated to be valuable for transportation professionals in both the public and private sectors who must provide estimates and expectations of the economic impacts of raised medians.

INTRODUCTION

Background

In recent years, transportation agencies have increased construction of raised medians on urban and suburban arterials. In addition to their use for access control, raised medians provide improved traffic operations and safety for a facility by separating opposing traffic flows and removing left-turning vehicles from the through lanes. With respect to access control, raised medians restrict left turns to mid-block and intersection median openings. While improving the operations and arterial signal coordination, the economic impacts of restricting these left turns may be felt by owners of businesses and properties adjacent to the arterial. Extensive research has investigated and quantified the costs and benefits of constructing raised medians with respect to initial costs and benefits to motorists in terms of reduced delay and increased safety. Prior to this research effort, however, limited research has been conducted to aid in estimating the economic impacts of raised medians on sales and property values for adjacent business and undeveloped landowners. The paper that follows is based upon the results of this four-year research effort (1,2,3,4).

Research Methodology

Participants in the survey included owners and managers of businesses adjacent to the corridors of interest. The research team first conducted a "windshield" survey to determine which businesses and land uses were present along the corridors in which the survey was to be administered. Business information (e.g., address and contact name) for each location was then obtained from the chamber of commerce, appropriate neighborhood/business groups, county appraisal district office, and/or telephone directories. For all but one of the corridors, the research team sent a letter of support from

the local chamber of commerce or neighborhood association encouraging the business owners and managers to participate in the survey. Finally, reminder cards were sent to the five case studies where mail-out surveys were administered to encourage business owners to return the surveys. In the final year of the study, surveys of customers wee performed along one corridor in College Station to compare to business owner responses.

Corridor Descriptions

The case studies include corridors with a variety of business mixes. Most of the corridors are in suburban-type areas with shopping centers and strip retail development. One of the corridors, Grant Avenue in Odessa, is located in a central business district. The specific types of development on the individual corridors ranges from completely retail to a mix of office, institutional, and retail. These development mixes drove the numbers of potential survey participants on each corridor. In addition, the cities included in the study reflect a variety of population sizes. The populations range from approximately 35,000 in McKinney to approximately 1.8 million in the City of Houston. Table 1 summarizes several different characteristics of interest for each case study location.

RESEARCH RESULTS

Importance of Access to Customers

One question on the business survey asked business owners to rank "accessibility to store" with other factors including, distance to travel, hours of operation, customer service, product quality, and product price in order of importance that customers use when selecting a business of their type. The results of this analysis by business type are shown in Table 2. In all cases, the accessibility to the

store ranked third or lower. Generally, accessibility was ranked lower than the items of customer service, product quality, and product price–all elements that business owners/managers themselves can directly influence. Customer surveys were also administered with this question as well. In all cases, the customers ranked accessibility with lower, or equal, value to the business owners. Accessibility is ranked as number two by the customers at one of the gas station locations after product price.

Impacts on Regular Customers

Another question of particular interest on the survey was business owner's perceptions of the impacts on regular customers due to the raised median installation. The business owners that were along the corridor before, during, and after the construction of the raised median indicated a smaller percentage of their regular customers would be less likely to visit their business as a result of the raised median compared to those business owners that were interviewed prior to the raised median installation (14.3 percent compared to 19.1 percent). Customers were also asked this question, and the majority of the customer survey responses match the business owner's selections at all five sites. Customers generally indicated that they would be less likely to visit the businesses during the construction phase of the project.

Impacts on Employment, Property Values, Accidents, and Traffic Volume

Impacts upon employment, property values, accidents, and traffic volume were also of interest. Results of these factors by business group are shown in Table 3. The "during" column in Table 3 indicates the impacts during construction relative to prior to the construction, and the "after" column

indicates the impacts after construction relative to prior to the construction. For all the business groups, the number of full-time employees increases on average. Business group two–those interviewed prior to the raised median installation–indicate that they felt the number of full-time employees would decrease slightly during construction while it actually increased 8.6 percent for the group one business owners. The perception of business owners was that property values increased 6.7 percent after the median installation (group one), but those business owners interviewed prior to the median installation expected a 2.3 percent decrease. The business owners also indicated a perceived decrease of 10.2 percent in accidents along with a 31.5 percent increase in traffic volumes.

Impacts on Customers Per Day and Gross Sales

Table 4 illustrates the impacts on customers per day and gross sales for the four business groups. "Gross sales where the median installed" refers to a question posed to business owners in which they were asked what they believe was/is the impact of the raised median for all businesses along the corridor where the median was installed. "Gross sales in the area" refers to a similar question that asked about gross sales for all other businesses in the area (not necessarily just the corridor) due to the raised median installation. One can quickly notice from Table 4 that the construction phase did seem to impact customers per day and gross sales as evidenced from the values in the "during" columns. Perceptions seem to indicate a larger expected loss in gross sales during construction (18.6 percent) compared to the percent reduction of 11.6 percent by those businesses that were present before, during, and after the median installation. Group one businesses also indicated an increase in customers per day and gross sales after the median installation while the group two businesses believed that there would still be a decrease. Group one also indicated an increase after the median

was installed for all businesses along the corridor where the median was installed and in the community surrounding the roadway improvement.

Impacts by Business Type

Table 5 provides results of analysis for group one businesses that have been present before, during, and after the median installation. The table presents the average percent change, standard deviation, and sample size by business type. One can see that the construction phase of the project appears to have a negative affect on many of the metrics of interest for many of the different business types. After construction of the raised median, gasoline stations, auto repair, and other services indicated a small negative affect on gross sales. These values are slightly lower for customers per day. Property values after construction are indicated as either rising or the same after the construction of the median, and there are only small changes in full- and part-time employees.

CONCLUSIONS AND RECOMMENDATIONS

It should be noted that the sample sizes upon which analyses were performed were often rather small; however, many observations and interesting points may be drawn from this research effort.

- ✔ The in-person surveys appear to provide more reliable data than the mail-out surveys, and these survey respondents appreciate the face-to-face opportunity to have their opinions heard. The average response rate for the in-person surveys was also much higher (55.0 percent) than the response rate for the mail-out surveys (9.0 percent).

- ✔ When asked to rank order the factors that affect customers endorsing their businesses, business owners generally ranked "accessibility to store" fourth or lower below some combination of customer service, product quality, and product price. According to business owners, it appears that the most important elements used by customers to determine what businesses they will endorse are factors that may be controlled by the business owners themselves to some extent. In surveys of customers at five selected businesses along the Texas Avenue corridor in College Station, it was found that customers ranked "accessibility to store" with lower, or equal, value to the business owners.

- ✔ When combining all business types, it was found that 85.7 percent of business owners whose businesses were present before, during, and after the median installation felt that their regular customers would be more likely (15.7 percent) or stay about the same in likeliness (70.0 percent) to endorse their business. In contrast, those businesses that were interviewed prior to the installation of the raised median indicated this percentage slightly lower (i.e., indicated more regular customers "less likely") at 80.9 percent. Therefore, for the case studies investigated in this project, the perceptions appear slightly more negative than what actually occurred along corridors where business owners were present before, during, and after the median installation. A similar question was posed to customers in College Station at the five selected businesses, and it was found that a majority of the customer survey responses matched the business owner's / manager's opinions. Generally, customers did indicate they were less likely to visit the business during the construction of the raised median.

- ✔ A majority of customers indicated that while the median made access more difficult, they indicated that customer satisfaction was better or that it remained about the same for the five businesses where customer surveys were performed.

- ✔ There was generally no change in the number of total employees along several of the corridors. Those corridors that did experience a decrease in the number of employees only experienced a decrease for one year and not over consecutive years.

- ✔ The construction phase seemed to impact customers per day and gross sales. For all businesses, perceptions again seem to indicate a larger expected loss in the businesses that were interviewed prior to the construction of the raised median. These business owners indicated they expected an 18.6 percent reduction in gross sales, while those that were present before, during, and after the median installation indicated an 11.6 percent reduction. After the construction phase, a 17.7 percent increase in customers per day was indicated along with a decrease in gross sales of 0.03 percent for all businesses present before, during, and after the median installation. Business types such as durables retail, specialty retail, fast-food restaurants, and sit-down restaurants indicated increasing customers per day, gross sales, and property values. Gas stations, auto repair, and other service businesses indicated decreasing customers per day and gross sales after the raised median was installed.

- ✔ The construction phase appears to have the most detrimental impacts on businesses. Suggestions to alleviate these impacts include, 1) ensuring adequate and highly visible access

to businesses during construction, 2) reducing construction time, and 3) performing the construction in smaller roadway segments (phases) to the extent possible.

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TABLE 1 Characteristics of Case Study Locations

Street Name	City and Population	Before Constr.	After Constr.	Study Limits	Length (miles)	Construction Years	Survey Type	Land Use	Number of Establishments
Texas Avenue	College Sta. 64,200	TWLTL	Raised Median	University Dr. to Dominik Dr.	1.5	1996 to 1998	Interview	Retail, University	59
South Post Oak Road	Houston 1,844,000	Undivided	Raised Median	I-610 to South Main Street	1.5	1988 to 1990	Interview	Retail, Industrial	155
Clay Road	Houston 1,844,000	Undivided	Raised Median	Hollister Rd. to Gessner Rd.	2.2	1994 to 1996	Mail-out	Retail, Industrial, Undeveloped	63
West Fuqua Road	Houston 1,844,000	Undivided	Raised Median	Hiram Clarke Rd. to Almeda Rd.	1.5	1987 to 1989	Mail-out	Retail, Undeveloped	68
Long Point Road	Houston 1,844,000	Undivided	Raised Median	Campbell Rd. to Hollister Rd.	0.7	Surveyed pre-constr.	Mail-out	Retail	41
Twin Cities Highway	Port Arthur 58,600	Raised Median	TWLTL	53rd Street to Griffing Park	2.0	1983 to 1985	Mail-out	Retail, Office	90
9th Avenue	Port Arthur 58,600	Undivided	Raised Median	Texas 365 to Lake Arthur Drive	1.5	1979 to 1980	Mail-out	Retail, Residential, Undeveloped	66
University Drive	McKinney 35,000	Undivided	Raised Median	U.S. 75 to Texas Highway 5	1.4	1991 to 1992	Interview	Retail, Residential	132
Loop 281	Longview 76,000	Flush Median	Raised Median	Spur 63 to Spur 502	0.6	1996	Interview	Retail	65
Call Field Road	Wichita Falls 98,200	Undivided	Raised Median	Kemp Blvd to Lawrence Street	0.3	Surveyed pre-constr.	Interview	Retail	55
Grant Avenue	Odessa 95,400	Undivided	Raised Median	2nd Street to 8th Street	0.6	1992	Interview	Retail, Office	42
Various	Amarillo 168,000	Raised Median	Undivided or TWLTL	Varies	Varies	Varies (1989-1995)	Interview	Retail	118

TABLE 2 Relative Importance Ranking of "Accessibility to Store" by Business Type

Business Type	Sample Size	Ranked Items					
		Distance to Travel	Hours of Operation	Customer Service	Product Quality	Product Price	Accessibility to Store
Durables Retail	2	5	5	2	2	1	5
Specialty Retail	23	6	5	1	2	3	4
Grocery	1	1	6	2	3	4	5
Gas Station	5	6	5	1	4	2	3
Fast-Food Restaurant	10	5	6	2	1	4	3
Sit-Down Restaurant	10	5	6	1	2	3	4
Medical	2	4	3	2	1	2	4
Auto Repair	6	5	3	1	2	4	6
Other Services	10	6	4	1	2	3	5

TABLE 3 Percent Change, Standard Deviation, and Sample Sizes of Full- and Part-Time Employees, Property Values, Accidents, and Traffic Volumes by Business Group

Business Group	Full-Time Employees		Part-Time Employees		Property Values		Accidents		Traffic Volume	
	During	After	During	After	During	After	During	After	During	After
1	8.6% 28.3 55	3.2% 20.0 57	-3.3% 19.7 53	-0.3% 12.2 55	1.5% 10.3 31	6.7% 15.8 38	5.5% 23.7 40	-10.2% 27.1 40	-12.5 21.1 38	31.5% 50.7 44
2	-0.3% 1.1 19	0.3% 7.8 18	-0.2% 0.9 18	-1.0% 4.9 17	-8.2% 22.5 14	-2.3% 11.8 13	-3.3% 23.0 18	-13.2% 33.5 14	-11.1% 25.0 19	7.9% 20.5 17
3	-6.3% 17.7 8	9.4% 26.5 8	-6.3% 17.7 8	0.0% 0.0 9	-5.8% 14.3 6	4.7% 7.7 7	-7.1% 18.9 7	-10.7% 28.3 7	-8.8% 27.5 8	28.8% 20.5 8
4	0.0% 0 3	7.1% 18.9 7	0.0% 0.0 3	6.3% 17.7 8	-15.6% 22.4 9	7.7% 12.9 11	0.0% 0.0 6	6.7% 18.6 12	-21.9% 23.9 8	37.7% 89.3 11

Note: Business Group 1 = businesses present before, during, and after median installation; Business Group 2 = businesses present before the median construction and construction is yet to begin; Business Group 3 = businesses present during and after median installation; and Business Group 4 = businesses present only after the median had been installed.

Note: The "during" column indicates impacts during construction relative to prior to construction, and the "after" column indicates impacts after construction relative to prior to construction.

TABLE 4 Percent Change, Standard Deviation, and Sample Sizes of Customers per Day, Gross Sales, Gross Sales Along the Portion Where the Median Was (Will Be) Located, and Gross Sales in the Area

Business Group	Customers per Day		Gross Sales		Gross Sales Where Median Installed		Gross Sales in the Area	
	During	After	During	After	During	After	During	After
1	-14.9% 30.6 54	17.7% 101.0 55	-11.6% 24.7 53	-0.03% 1.5 61	-16.4% 18.5 37	8.5% 20.5 35	7.6% 17.5 25	1.2% 7.1 22
2	-9.5% 31.8 18	-5.9% 10.0 16	-18.6% 24.8 19	-0.8% 1.6 16	-14.2% 17.2 13	5.4% 22.9 14	11.8% 14.5 14	2.7% 6.0 13
3	-15.6% 22.9 8	-3.9% 22.6 9	-17.9% 23.8 7	0.0% 1.2 9	-12.95% 18.7 7	13.6% 20.6 7	0.7% 15.9 7	0.7% 18.8 7
4	0.0% 0.0 2	50.0% 105.6 8	0.0% - 1	0.3% 1.5 7	-20.4% 17.8 12	12.9% 18.1 12	9.5% 13.7 11	5.9% 13.8 11

Note: Business Group 1 = businesses present before, during, and after median installation; Business Group 2 = businesses present before the median construction and construction is yet to begin; Business Group 3 = businesses present during and after median installation; and Business Group 4 = businesses present only after the median had been installed.

Note: The "during" column indicates impacts during construction relative to prior to construction, and the "after" column indicates impacts after construction relative to prior to construction.

TABLE 5 Summary of Average Percent Change, Standard Deviation, and Sample Size for Responses from Businesses Present Before, During, and After Raised Median Installation (Group One Businesses)

Business Type	Total Sample Size	Percent Change in Responses of Interest									
		Customers per Day		Gross Sales		Property Values		Full-Time Employees		Part-Time Employees	
		During	After	During	After	During	After	During	After	During	After
Durables Retail	2	15.0% - 1	5.0% - 2	15.0% - 1	1.0% - 2	1.0% - 1	17.5% 3.5% 2	- - 0	0.0% - 1	0.0% - 1	0.0% - 1
Specialty Retail	23	-6.6% 14.0% 19	8.1% 12.8% 18	-5.6% 15.6% 19	0.4% 1.2% 21	-1.0% 3.2% 10	3.7% 17.9% 13	22.0% 41.0% 20	1.0% 11.4% 20	0.9% 14.1% 19	-5.3% 16.8% 19
Gas Station	5	-20.4% 68.1% 5	-17.6% 23.3% 5	-40.4% 24.8% 5	-2.4% 1.3% 5	16.7% 28.9% 5	20.0% 26.5% 5	2.6% 19.1% 5	-5.0% 11.2% 5	-20.0% 44.7% 5	0.0% 0.0% 5
Fast-Food Restaurant	11	-19.9% 37.0% 8	108.9% 237.6% 9	-8.6% 36.1% 7	0.4% 1.5% 7	-17.0% 12.6% 3	16.7% 8.8% 6	-3.7% 26.6% 6	30.8% 46.3% 6	-15.3% 30.0% 7	3.0% 13.3% 7
Sit-Down Restaurant	10	-6.1% 8.8% 7	2.6% 3.6% 7	-3.6% 10.6% 7	0.8% 0.4% 10	0.0% 0.0% 4	0.0% 0.0% 4	1.8% 5.0% 9	3.5% 8.2% 10	1.8% 5.0% 9	5.0% 10.5% 10
Auto Repair	7	-24.0% 25.1% 5	-5.0% 11.2% 5	-20.0% 24.5% 6	-0.5% 1.2% 6	3.3% 5.8% 3	3.3% 5.8% 3	0.0% 0.0% 5	0.0% 0.0% 5	0.0% 0.0% 4	0.0% 0.0% 4
Other Services	12	-32.5% 35.7% 8	-8.4% 9.3% 8	-17.5% 36.6% 6	-1.0% 1.7% 8	2.0% 4.5% 5	7.6% 10.8% 5	3.1% 5.9% 8	-4.4% 18.8% 8	0.0% 0.0% 7	1.4% 3.8% 7

Note: Each cell contains the average percent change (top), standard deviation (middle), and number of observations (bottom).

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